CSES7800: Deep Learning for Environmental Sciences

Department of Crop, Soil, and Environmental Sciences, Auburn University

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Spring 2024 10:00-11:15am M, W Classroom: Funchess 362 Credits: 3

Course Description and Objectives

The course will cover concepts and applications of deep learning in environmental sciences. The goal is to understand the concepts of deep learning methods for environmental sciences, formulate relevant environmental, climate, and earth system science problems, and how to use these methods for understanding and developing creative solutions to these problems.

Course Outcomes

After taking this course, students will understand the concepts of deep learning applications, implement deep learning methods with Python using environmental data, and tailor these methods to understand and solve environmental science problems.

Course Content and Schedule*

This course covers environmental data analysis foundations, concepts deep learning for the environmental systems, and practical applications with Python. *The following course schedule is tentative. As the course progresses, the schedule may be adjusted.

- Week 1: Introduction to deep learning for environmental sciences
- Week 2: Foundations and Python for environmental data analysis
- Week 3: Spatial, sequential, and high dimensional environmental data 1
- Week 4: Spatial, sequential, and high dimensional environmental data 2
- Week 5: Feedforward Neural Networks for environmental sciences
- Week 6: Deep Feedforward Neural Networks for environmental sciences
- Week 7: Structuring deep learning projects for environmental sciences
- Week 8: Regularizations to Improve deep neural networks
- Week 9: Optimizations in deep neural network
- Week 10: Hyperparameter tuning and batch normalization for improving deep neural network
- Week 11: Foundations of Convolutional Neural Networks
- Week 12: Deep Convolutional Models for environmental sciences
- Week 13: Sequence models for environmental sciences
- Week 14: Knowledge guided deep learning for environmental sciences
- Week 15: Final project due and presentations

Practice and Assessment:

Five reading assignments to learn state-of-the-art research on deep learning in earth system science; Five homework to practice deep learning methods in earth system science through Python programming with TensorFlow; Final project to explore a specific research or application issue with a deep learning method.

Learning Resources

The instructor will provide other electronic books, papers, example codes, and learning resources as the course progresses.

Grading Scale:

Percent
20%
40%
40%

	Grade	Percentage Range
•	А	90 to 100
•	В	80 to 89
•	С	70 to 79
•	D	60 to 69
•	F	59 or lower

Classroom Policies

Excused Absences: Students are granted excused absences from class for the following reasons: Illness of the student or serious illness of a member of the student's immediate family, death of a member of the student's immediate family, trips for student organizations sponsored by an academic unit, trips for University classes, trips for participation in intercollegiate athletic events, subpoena for a court appearance and religious holidays. Students who wish to have an excused absence from this class for any other reason must contact the instructor in advance of the absence to request permission. The instructor will weigh the merits of the request and render a decision. When feasible, the student must notify the instructor prior to the occurrence of any excused absences, but in no case shall such notification occur more than one week after the absence. Appropriate documentation for all excused absences is required.

Make-Up Policy: Arrangements to make up missed major examination (e.g. hour exams, mid-term exams) due to properly authorized excused absences. Except in unusual circumstances, such as continued absence of the student or the advent of University holidays, a make-up exam will take place within two weeks from the time the student initiates arrangements for it. Except in extraordinary circumstance, no make-up exams will be arranged during the last three days before the final exam period begins. The format of the make-up exam will be (as specific by the instructor).

Face Coverings: Auburn University permits individual faculty members to require face coverings in their classrooms. Students in this class are required to wear face coverings that appropriately cover the nose and mouth to limit the spread of infectious disease. Failure to comply with the requirement represents a potential Code of Student Conduct violation and may be reported as a non-academic violation. Please consult the <u>Policy on Classroom Behavior (Links to an external site.)</u> for additional details.

Comply with the provisions of the Americans with Disabilities Act: Students who need accommodations are asked to electronically submit their approved accommodations through AU Access and to make an individual appointment with the instructor during the first week of classes – or as soon as possible if accommodations are needed immediately. If you have not established accommodations through the Office of Accessibility, but need accommodations, make an appointment with the Office of Accessibility, 1228 Haley Center, 844-2096 (V/TT).

Academic Honesty: All portions of the Auburn University Student Academic Honesty code (Title XII) found in the <u>Student Policy eHandbook (Links to an external site.</u>) will apply to this class. All academic honesty violations or alleged violations of the SGA Code of Laws will be reported to the Office of the Provost, which will then refer the case to the Academic Honesty Committee.

Classroom Behavior: The Auburn University Classroom Behavior Policy is strictly followed in the course; please refer to the <u>Student Policy eHandbook (Links to an external site.)</u> for details of this policy.

Emergency Contingency: If normal class and/or lab activities are disrupted due to illness, emergency, or crisis situation (such as an H1N1 flu outbreak), the syllabus and other course plans and assignments may be modified to allow completion of the course. If this occurs, an addendum to your syllabus and/or course assignments will replace the original materials.